

From Theory to Action: Developing and Evaluating Learning Analytics for Learning Design

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ABSTRACT

The effectiveness of using learning analytics for learning design primarily depends upon two concepts: grounding and alignment. This is the primary conjecture for the study described in this paper. In our design-based research study, we design, test, and evaluate teacher-facing learning analytics for an online inquiry science unit on global climate change. We design our learning analytics in accordance with a socioconstructivism-based pedagogical framework, called Knowledge Integration, and the principles of learning analytics Implementation Design. Our methodology for the design process draws upon the principle of the Orchestrating for Learning Analytics framework to engage stakeholders (i.e. teachers, researchers, and developers). The resulting learning analytics were aligned to unit activities that engaged students in key aspects of the knowledge integration process. They provided teachers with actionable insight into their students' understanding at critical junctures in the learning process. We demonstrate the efficacy of the learning analytics in supporting the optimization of the unit's learning design. We conclude by synthesizing the principles that guided our design process into a framework for developing and evaluating learning analytics for learning design.

CCS CONCEPTS

• **General and reference** → **Design**; *Empirical studies*.

KEYWORDS

learning analytics, learning design, design-based research, theory, TEL environment

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1 INTRODUCTION

The central purpose of learning analytics (LA) for learning design can be found in the LAK definition of LA: to support the understanding of learning and the optimization of the learning context [5]. While many design efforts have attended to either aspect of this purpose, few have been successful at attending to both [13]. In their recent systematic literature review of LA for learning design studies, Mangaroska and Giannakos [13] identify numerous factors that limit the efficacy of LA for learning design, including the lack of grounding in a theory of learning and the lack of alignment with a theory-grounded learning design. Not grounding LA in a theory of learning can lead to a haphazard selection of data for LA development, biasing towards data that is simply proximal to rather than consequential for learning [17]. Not aligning LA to the learning design makes them inactionable, regardless of how interpretable they may be. We argue that in order for LA for learning design to accomplish their dual purpose of supporting the understanding of learning and optimizing the learning context, they must be developed using a strategy that attends to both of these aspects.

In this paper, we describe the development and evaluation of LA for learning design for which we used a design-based research methodology focused on inter-stakeholder dialogue. We draw upon principles of LA Implementation Design (LAID) and the Knowledge Integration (KI) pedagogical framework to develop teacher-facing LA to improve the learning design of an online middle school inquiry science unit on global climate change. We collaborated with five teachers, who had previously taught the unit, to identify, in accordance with our chosen theory of learning, several assessment items for which to develop LA. These LA leveraged data from a simple platform feature to provide teachers with an idea-focused analysis of their students' understanding. Our evaluation focuses on four issues: 1.) the efficacy of the LA data to identify students' learning needs, 2.) whether the analysis supported teachers in understanding their students' learning needs, 3.) whether the analytics informed the optimization of the learning design, and 4.) whether the LA report informed teachers' pedagogical action.

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